F
Tech
B

British Standards Institution
Report

No. 15—1912.

British Engineering Standards Association.

(Incorporated 1918.)

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE

BY

THE INSTITUTION OF CIVIL ENGINEERS.
THE INSTITUTION OF MECHANICAL ENGINEERS.
THE INSTITUTION OF NAVAL ARCHITECTS.
THE IRON AND STEEL INSTITUTE.
THE INSTITUTION OF ELECTRICAL ENGINEERS.

UNIVERSITY OF TORONTO
MAY 19 1920
LIBRARY

BRITISH STANDARD SPECIFICATION FOR STRUCTURAL STEEL FOR BRIDGES, ETC., AND GENERAL BUILDING CONSTRUCTION.

(REVISED AUGUST, 1912.)

LONDON:
PUBLISHED FOR THE ASSOCIATION BY CROSBY LOCKWOOD & SON,
7, STATIONERS' HALL COURT, LUDGATE HILL, E.C. 1; AND 5, BROADWAY, WESTMINSTER, S.W. 1,
AND TO BE PURCHASED FROM ANY BOOKSELLER, OR DIRECT FROM THE OFFICES OF THE ASSOCIATION,
28, VICTORIA STREET, WESTMINSTER, S.W. 1.
June, 1918.

COPYRIGHT. ALL RIGHTS RESERVED.

Price 1/- Net.

No. 15—1912.

British Engineering Standards Association.

(Incorporated 1918.)

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE

BY

THE INSTITUTION OF CIVIL ENGINEERS.
THE INSTITUTION OF MECHANICAL ENGINEERS.
THE INSTITUTION OF NAVAL ARCHITECTS.
THE IRON AND STEEL INSTITUTE.
THE INSTITUTION OF ELECTRICAL ENGINEERS.

BRITISH
STANDARD SPECIFICATION
FOR
STRUCTURAL STEEL
FOR
BRIDGES, ETC., AND GENERAL BUILDING CONSTRUCTION.

(REVISED AUGUST, 1912.)

LONDON:
PUBLISHED FOR THE ASSOCIATION BY CROSBY LOCKWOOD & SON,
7, STATIONERS' HALL COURT, LUDGATE HILL, E.C. 1; AND 5, BROADWAY, WESTMINSTER, S.W. 1,
AND TO BE PURCHASED FROM ANY BOOKSELLER, OR DIRECT FROM THE OFFICES OF THE ASSOCIATION.
28, VICTORIA STREET, WESTMINSTER, S.W. 1,
June, 1918.

COPYRIGHT. ALL RIGHTS RESERVED.

Price 1/- Net.

CONTENTS.

PAGE
List of Members of Main Committee 3
List of Members of Sectional Committee on Bridges and General Building Construction 4
Preface to First Edition 5
Preface to First Revision 5

SPECIFICATION: TABLE OF CLAUSES.

1. Process of Manufacture—
  A Steel (Open Hearth) 7
  B Steel (Open Hearth or Bessemer)... 7
2. Quality of Finished Steel 7
3. Tensile Test Pieces 8
4. Selection of Tensile Test Pieces... 8
5. Tensile Tests—
  (*a*) Plates, Sections and Flat Bars 8
  (*b*) Round and Square Bars 9
  (*c*) Rivet Bars 9
6. Number of Tensile Tests—
  (A) Plates, Sections and Flat Bars 9
  (B) Round and Square Bars 9
  (C) Rivet Bars 10
7. Cold and Temper Bend Test Pieces 10
8. Selection of Bend Test Pieces 10
9. Cold Bend Tests 10
10. Temper Bend Tests 11
11. Number of Cold and Temper Bend Tests 11
12. Number and Kind of Tests of Manufactured Rivets ... 11
13. Tests by Chemical Analysis 11
14. Maker's Tests at his Works 11
15. Purchaser's Tests elsewhere 12
16. Additional Tests 12
17. Inspection 12
18. Margin Over and Under Dimensions and Weights ... 12
19. Calculation of Weight 13
20. Identification of Cast 13
21. Branding or Marking 13
22. Maker's Certificate—
  (*a*) When no Inspection has taken place 13
  (*b*) When Steel is taken from Stock 14
23. Non-compliance with Tests and Requirements... ... 14
24. Delivery 14
25. Rejection after Delivery 14
26. Arbitration 14

CONVERSION TABLE.

Tons to Pounds 16

APPENDIX.

Forms of British Standard Tensile Test Pieces 18

BRITISH ENGINEERING STANDARDS ASSOCIATION.

MAIN COMMITTEE.

† SIR ARCHIBALD DENNY, BART. (*Chairman*).

SIR MAURICE FITZMAURICE, C.M.G. (*Vice-Chairman*).

SIR WILLIAM MATTHEWS, K.C.M.G. ...	Nominated by the Institution of Civil Engineers.
SIR DOUGLAS FOX ...	
MR. R. ELLIOTT-COOPER ...	
MR. ALEXANDER ROSS ...	
DR. W. C. UNWIN ...	
MR. H. A. IVATT ...	Nominated by the Institution of Mechanical Engineers.
MR. MICHAEL LONGRIDGE ...	
DR. WILLIAM H. MAW ...	
MR. G. AINSWORTH ...	Nominated by the Iron and Steel Institute.
DR. ARTHUR COOPER ...	
MR. ILLTYD WILLIAMS ...	
SIR THOMAS BELL, K.B.E. ...	Nominated by the Institution of Naval Architects.
SIR WILLIAM SMITH, C.B. ...	
COL. R. E. CROMPTON, C.B. ...	Nominated by the Institution of Electrical Engineers.
SIR JOHN SNELL ...	
MR. C. P. SPARKS ...	
MR. F. R. DAVENPORT ...	Co-opted by the Nominated Members to represent the Federation of British Industries.
MR. F. W. GILBERTSON ...	
HON. SIR CHARLES PARSONS, K.C.B. ...	Co-opted by the Nominated Members.
SIR ROBERT HADFIELD, BART. ...	
SIR RICHARD GLAZEBROOK, C.B. ...	

DR. J. H. T. TUDSBERY (*Hon. Secretary*).

MR. C. LE MAISTRE (*Secretary*).
MR. CHARLES DRESSER (*Assistant Secretary*).

---

† Succeeded the late SIR JOHN WOLFE BARRY, K.C.B., February, 1918.

BRITISH ENGINEERING STANDARDS ASSOCIATION.

The following is the list of Members of the Sectional Committee on Bridges and General Building Construction which was entrusted with the present revision of the Standard Specification.

SECTIONAL COMMITTEE ON BRIDGES AND GENERAL BUILDING CONSTRUCTION.

August, 1912.

Chairman, Mr. R. ELLIOTT-COOPER.

Admiralty, Mr. F. W. Kite.

War Office, Major A. G. Stevenson, D.S.O., R.E.

Crown Agents for the Colonies, Mr. G. L. Eyles, C.M.G. ; Mr. Ashton M. Heath.

Royal Institute of British Architects, Mr. Edwin T. Hall.

Concrete Institute,† Mr. W. G. Kirkaldy.

London County Council, Mr. F. S. Capon ; Mr. W. C. Copperthwaite ; Mr. E. Fiander Etchells.

Railway Engineers' Association, Mr. E. C. Trench.

Steel Ingot Makers' Association, Mr. George Ainsworth ; Mr. Maxmilian Mannaberg.

Mr. S. Bylander ; †Mr. G. A. Hobson ; Mr. F. Hudleston (*Hudleston & Vigers*) ; Mr. Christopher Moody (*Dorman, Long & Co., Ltd.*) ; †Mr. F. E. Robertson, C.I.E (*Rendel & Robertson*) ; Mr. Henry C. Simpson (*The Horsehay Co., Ltd.*) ; Mr H. J. Skelton (*H. J. Skelton & Co.*) ; Mr. J. D. Stitt (*Redpath, Brown & Co., Ltd.*) ; *Mr. W. Turner MacLellan (*P. & W. MacLellan, Ltd.*).

---

* Succeeded Mr. J. Hamilton Turner, May, 1912.

† Since deceased.

PREFACE TO FIRST EDITION.

The Sectional Committee on Bridges and General Building Construction was appointed by the Main Committee on July 19th, 1901.

Having, in conjunction with the Sectional Committee on Ships' Sections and the Sectional Committee on Railway Rolling Stock Underframes, completed the Standard list of Rolled Sections for Structural purposes, the Committee next turned their attention to a Standard Specification for Structural Steel for Bridges and General Building Construction. The draft of the Specification was submitted to the Science Standing Committee of the Royal Institute of British Architects, and certain modifications have been introduced into the Specification as a result of the co-operation of that Committee. The Specification was adopted by the Sectional Committee on Bridges and General Building Construction at their meeting held on May 23rd, 1906.

This Report was approved by the Main Committee at their meeting held on June 19th, 1906.

B. BAKER,
Chairman of the Sectional Committee on Bridges and General Building Construction.

PREFACE TO FIRST REVISION.

Since the first issue of the Specification in June, 1906, the Committee have from time to time had brought before them points which had arisen in connection with its use, and the present issue embodies the Committee's decisions in regard to these. Some of the more important modifications to the Specification are as follows:—

1. The classification of the material dealt with into **A** Steel and **B** Steel.
2. The increase of the allowable Phosphorus Content in **B** Steel from 0·07 to 0·08 per cent.
3. The increase of the upper limit of tensile strength for plates, sections and bars (other than rivet bars), from 32 to 33 tons per square inch.
4. The reduction of the lower limit of tensile strength for rivet bars from 26 to 25 tons per square inch
5. The insertion of Clauses dealing with (*a*) tests by an Independent Expert, (*b*) Rejection after delivery, and (*c*) Arbitration in cases where this is not otherwise provided for.

The text of the Specification has been settled in consultation with the Committee by Mr. A. A. Hudson, K.C. (Standing Counsel to the Committee), with a view of ensuring that so far as practicable it has the meaning intended by them, and the Specification has been remodelled in accordance with his advice.

The Specification in its present form was approved by the Sectional Committee at their meeting on April 26th, 1912, and by the Main Committee on July 18th, 1912.

R. ELLIOTT-COOPER,

Chairman of the Sectional Committee on Bridges and General Building Construction.

Note.—*The Association desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the material herein referred to, but does not purport to include all the necessary provisions of a Contract.*

BRITISH
STANDARD SPECIFICATION
FOR
STRUCTURAL STEEL
FOR
BRIDGES, ETC., AND GENERAL BUILDING CONSTRUCTION.

(REVISED AUGUST, 1912.)

Process of Manufacture.

1. **A** steel shall be made by the Open Hearth Process (Acid or Basic), unless either process is required or specified, and must not show on analysis more than 0·06 per cent. of Sulphur or of Phosphorus.

B steel may be made either by the Open Hearth Process (Acid or Basic), or by the Bessemer Process (Acid or Basic), unless any one of the four processes is required or specified, and must not show on analysis more than 0·08 per cent. of Phosphorus, and not more than 0·06 per cent. of Sulphur.

NOTE.—**B** steel is not intended for Bridges, nor for Plates $\frac{1}{4}$ inch in thickness and over, and Rivet Bars.

Quality of Finished Steel.

2. All finished steel as sent from the mills shall, subject to the provisions of Clause 18, be well and cleanly rolled to the dimensions, sections and weights specified or required, shall be sound and free from cracks, surface flaws, laminations, rough, jagged and imperfect edges and all other defects, shall be finished in a workmanlike manner and shall in all respects comply with the tests and requirements herein mentioned applicable to the description of material (*e.g.*, plates, sections, bars, rivets, etc.) required or specified.

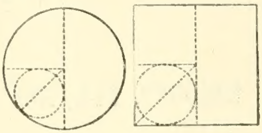
Tensile Test Pieces.

3. The tensile strength and elongation of all steel shall be determined from Standard Test Pieces cut lengthwise and crosswise from plates, and lengthwise from sections and bars.

The test pieces shall not be annealed, or otherwise subjected to heat treatment, unless the material from which they are cut is similarly treated, in which case the test pieces shall be similarly and simultaneously treated with the material before testing.

Any straightening of test pieces which may be required shall be done cold.

The rolled surface of the steel wherever practicable shall be retained on two opposite sides of the test piece, but in the case of bars having diameters or sides not exceeding 3 inches the bars may be reduced by turning. For bars having diameters or sides above 3 inches the test piece may, at the option of the Maker, be taken from the position shown in the sketches.



Selection of Tensile Test Pieces.

4. Tensile test pieces shall be selected by the Purchaser or by the Engineer* or Inspector†—

(*a*) Either from the shearings, or, if he so desire,

(*b*) From the plates, sections and bars, after they have been cut to the sizes required.

In the latter case (*b*), if the test is satisfactory, the Purchaser shall pay the Maker the value of the plate, section, or bar from which the test piece has been cut, or accept delivery of the same as though such test piece had not been cut therefrom.

In neither case (*a* or *b*) shall the test pieces be detached from the plates, sections, or bars, except in the presence of the Purchaser or of the Engineer or Inspector.

Tensile Tests.

5. The tensile breaking strength of all steel determined from the Standard Test Pieces hereinafter referred to, shall be as follows:—

(*a*) *Plates*, *Sections* (e.g., *Angles*, *Tees*, *Joists*, *Channels*, *etc.*), *and Flat Bars.*—The tensile breaking strength of all plates, sections (such as angles, tees, joists, channels, etc.) and flat bars, except where required for welding, shall be between the limits of 28 and 33 tons per square inch of section. The elongation measured on the Standard Test Piece **A** (see Appendix, page 18) shall be not less than 20 per cent. for steel of 0·375 inch in thickness and upwards, and not less than 16 per cent. for steel below 0·375 inch in thickness.

---

* The word "Engineer" shall include any Engineer or Architect supervising or acting as Engineer or Architect in connection with the manufacture or supply of steel or the works for which the steel is required.

† The word "Inspector" shall include any person acting under the direction of such Engineer or Architect.

(*b*) *Round and Square Bars.*—The tensile breaking strength of round and square bars (other than rivet bars) shall be between the limits of 28 and 33 tons per square inch of section, with an elongation of not less than 20 per cent. measured on the Standard Test Piece **B** (see Appendix, page 19), or not less than 24 per cent. measured on the Standard Test Piece **F** (see Appendix, page 20). The bars may be tested the full size as rolled.

(*c*) *Rivet Bars.*—The tensile breaking strength of rivet bars shall be between the limits of 25 and 30 tons per square inch of section, with an elongation of not less than 25 per cent. measured on the Standard Test Piece **B** (see Appendix, page 19) or not less than 30 per cent. measured on Standard Test Piece **F** (see Appendix, page 20). The bars may be tested the full size as rolled.

Generally. — Provided that for steel under $\frac{5}{16}$ of an inch (0·312 in.) in thickness or diameter bend tests only shall be required.

Number of Tensile Tests.

6. (A) *For Tensile Tests Clause* 5, *Sub-Section* (*a*).—One tensile test shall be made from the finished steel from each cast unless the quantity of the steel from one cast at the thickness tested exceeds 25 tons, in which case a second tensile test shall be made. One additional test shall also be made from each cast for every variation in thickness of 0·15 of an inch in the plates, sections, or flat bars.

(B) *For Tensile Tests Clause* 5, *Sub-Section* (*b*).—One tensile test shall be made from the finished steel from each cast, unless the quantity of the steel from one cast exceeds 25 tons, in which case a second tensile test shall be made. When more than one diameter or thickness of bar is required or specified one additional test shall be made from each diameter or thickness of bar ordered, if desired by the Purchaser or by the Engineer or Inspector.

(C) *For Tensile Test Clause* 5, *Sub-Section* (*c*).—One tensile test shall be made from each cast, unless the weight of the rivet bars, as rolled, from one cast exceeds 10 tons, in which case an additional tensile test shall be made for each further 10 tons or portion thereof.

Cold and Temper Bend Test Pieces.

7. Bend tests of all steel (other than Rivet Bars) shall be made from test pieces prepared as follows:—Bend test pieces shall be sheared or cut lengthwise or crosswise from plates and lengthwise from sections and round and square bars and shall be not less than 1½ inches wide, but for round or square bars of less than 2 inches diameter or side, or flat bars of less than 2 inches wide, pieces cut from the bar as rolled may be used.

In all cold bend tests, and in temper bend tests on samples 0·5 inch in thickness and above, the rough edge or arris caused by shearing may be removed by filing or grinding, and samples 1 inch in thickness and above may have the edges machined, but the test pieces shall receive no other preparation.

The test pieces shall not be annealed, or otherwise subjected to heat treatment, unless the material from which they are cut is similarly treated, in which case the test pieces shall be similarly and simultaneously treated with the material before testing.

Selection of Bend Test Pieces.

8. Bend test pieces shall be selected by the Purchaser or by the Engineer or Inspector—

(*a*) Either from shearings, or, if he so desire,

(*b*) From the plates, sections and bars, after they have been cut to the sizes required or specified.

In the latter case (*b*), if the test is satisfactory, the Purchaser shall pay the Maker the value of the plate, section, or bar from which the test piece has been cut, or accept delivery of the same as though such test piece had not been cut therefrom.

Cold Bend Tests.

9. For cold bend tests the test piece shall withstand, without fracture, being doubled over either by pressure or by blows from a hammer until the internal radius is not greater than 1½ times the thickness of the test piece, and the sides are parallel.

For sections having flanges less than 2 inches wide these bend tests may be made from the flattened section.

Temper Bend Tests.

10. For temper bend tests the test piece shall be heated to a blood red and quenched in water at a temperature not exceeding 80 degrees Fahr. The colour shall be judged indoors in the shade. The test piece shall then withstand, without fracture, being doubled over either by pressure or by blows from a hammer until the internal radius is not greater than 1½ times the thickness of the test piece, and the sides are parallel.

For sections having flanges less than 2 inches wide these bend tests may be made from the flattened section.

Number of Cold and Temper Bend Tests.

11. Either a cold or temper bend test shall be made from each plate, section, or bar (other than rivet bars) as rolled, and these two kinds of tests shall be in about equal number from the material ordered.

For rivet bars cold or temper bend tests are not required.

Number and Kind of Tests of Manufactured Rivets.

12. Manufactured rivets selected from the bulk, in such number as may be specified or as may be approved by the Purchaser or by the Engineer, shall withstand the following tests :—

(*a*) The rivet shanks to be bent cold, and hammered until the two parts of the shank touch in the manner shown in Fig. 1, without fracture on the outside of the bend.

(*b*) The rivet heads to be flattened, while hot, in the manner shown in Fig. 2, without cracking at the edges. The head to be flattened until its diameter is 2½ times the diameter of the shank.

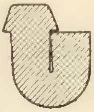


FIG. 1.

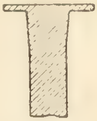


FIG. 2.

Tests by Chemical Analysis.

13. The Maker shall supply an analysis of each cast of steel when required so to do by the Purchaser or by the Engineer, but samples may also be taken by the Purchaser or by the Engineer or Inspector, and at the expense of the Purchaser may be subjected to complete analysis by a metallurgist appointed by him.

Maker's Tests at his Works.

14. All the test pieces after they have been marked for testing shall (except as provided in Clause 15) be prepared by the Maker and tested at his works and at his cost (and, if the Purchaser or Engineer so desire), in the presence of the Purchaser or of the

Engineer or Inspector. If the Maker fails to prepare properly the test pieces for testing or to test the steel properly at his works in the manner herein provided, the Purchaser or the Engineer may, at the Maker's cost, have the test pieces prepared for testing and the steel tested elsewhere.

Purchaser's Tests Elsewhere.

15. Four days' notice shall be given by the Maker to the Purchaser and to the Engineer of the date when he will be ready for the Purchaser or the Engineer or Inspector to select the test pieces. If within 7 days after the receipt of such notice the Purchaser or the Engineer shall give notice in writing to the Maker that he desires the test pieces to be prepared and tested at a place to be named in the notice within the United Kingdom, the tests shall then be carried out at such place and at the Purchaser's cost (and if the Maker so desire in the presence of the Maker or of the person deputed by him to witness the tests). In the event of such notice being given by the Purchaser or by the Engineer, the Maker shall be allowed at least 7 days from the receipt of such notice before the selection of the test pieces. The tests must be completed within 14 days from the selection of the test pieces, failing which the tests shall be carried out at the Maker's works.

Additional Tests.

16. Should a tensile test piece break outside the middle-half of its gauge length, the test may, at the Maker's option, be discarded, and another test be made of the same plate, section or bar. In all other cases should any of the test pieces or rivets first selected not fulfil the tests applicable to the description of material to be tested, two additional test pieces or rivets may be taken, and should either of them fail to fulfil such tests, all steel from the cast from which the test pieces have been taken may be rejected. The additional tests shall be carried out in the same manner in all respects as the tests hereinbefore required to be made in the first instance.

Inspection.

17. The Purchaser, the Engineer and the Inspector shall at all reasonable times have free access to the Maker's works, and to all places under his control where steel is being manufactured, and shall be at liberty to inspect the manufacture of the steel at all stages.

Margin Over and Under Dimensions and Weights.

18. (*a*) *Specified lengths.*—When steel in bars or sections is specified to be cut to certain lengths it shall be cut within a margin of 1 in. under or 1 in. over the specified length, but if the Maker is required to take his cutting margin over and not under the length specified, the margin shall be within 2 ins. over.

(*b*) *Exact lengths.*—Where "exact" lengths are specified, the steel in bars or sections shall be cold sawn or machined within a margin of $\frac{1}{8}$ in. over or under the length specified.

(*c*) *Weights.*—The rolling margin on plates, sections and bars shall be between $2\frac{1}{2}$ per cent. over and $2\frac{1}{2}$ per cent. under the specified weights. Where a minimum weight of section of steel is specified the margin shall be 5 per cent. over. Where a maximum weight of section of steel is specified the margin shall be 5 per cent. under.

Calculation of Weight.

19. The weight of plates shall be calculated on the basis that steel weighs 40·8 lbs. per square foot per inch of thickness, and the weight of sections and bars on the basis that steel weighs 3·4 lbs. per square inch of sectional area per foot run.

Identification of Cast.

20. The Maker shall mark the ingots, billets, slabs, plates, sections, bars, etc., in such a way as to enable all finished steel to be traced to the original cast. Every facility for tracing the steel to the original cast shall be given to the Purchaser and to the Engineer and Inspector.

Branding or Marking.

21. Every piece of steel shall be legibly marked with the Maker's name or trade mark, and with cast numbers or identification marks by which the steel can be traced to the cast from which it was made. For rivet bars and small pieces securely bundled, a metal tag marked with the cast number will be sufficient.

Before the test pieces are selected, the Maker shall furnish the Purchaser with copies of the mill sheets, giving complete lists of all plates, sections or bars in each cast, with sizes and weights, and the numbers or marks by which each plate, section or bar can be identified.

Maker's Certificate.

22. (*a*) *When no Inspection has taken place.*—In the case of any steel which has not been inspected at the Maker's works, the Maker or Merchant, as the case may be, shall supply the Purchaser and the Engineer with a certificate stating the process of manufacture and a test sheet signed by the Maker giving the results of each of the mechanical tests applicable to the description of material purchased, and if and when required of the chemical analysis also. Each test sheet shall indicate the numbers or identification marks of the casts to which it applies, corresponding with the numbers to be found on the plates, sections, bars, etc.

(*b*) *When Steel is taken from Stock.*—Where any steel is taken from a Merchant's stock, the Purchaser or the Engineer may either (i) have the steel tested at such place as is in Clause 15 provided and at his own expense, or (ii) the Merchant shall satisfy the Purchaser or the Engineer by means of numbers or identification marks on the steel, combined with a Maker's certificate, that such steel has been tested and complies with the whole of the tests and requirements of this Specification applicable to the description of material required or specified.

Non-compliance with Tests and Requirements.

23. Should any steel not comply with the whole of the foregoing tests and requirements applicable to the description of material required or specified, all the steel in the cast from which the tests have been taken may, subject to the option of making additional tests as provided in Clause 16, be rejected.

Delivery.

24. No steel shall be despatched from the Maker's works until it has been tested and complies with, or has been certified (in the cases mentioned in Clause 22) to comply with, the whole of the tests and requirements of this Specification applicable to the description of material required or specified.

Rejection after Delivery.

25. The foregoing tests shall, except as provided for in Clause 15 and in Clause 22, Sub-Section (*b*), be made at the Maker's works prior to despatch, but in the event of any of the steel proving unsatisfactory in the course of being worked, such steel may be rejected notwithstanding any previous acceptance.

Arbitration.

26. In case any dispute shall arise between the parties to any contract in which this Specification is in whole or part incorporated as to whether any process of manufacture required or specified, or any test or requirement of this Specification has or has not been carried out or complied with, or as to whether any steel is or is not of the quality or free from the defects mentioned in Clause 2, or as to whether any steel proves unsatisfactory in the course of being worked as provided in Clause 25, then such dispute shall be referred to the arbitration of a person to be appointed, at the request of either party to the said dispute, by the Chairman for the time being of the Engineering Standards Committee, provided always that if such dispute is within the terms of any other agreement to refer or submit to arbitration this Clause shall be of no effect.

Conversion Table.

Tons.	Pounds.	Tons.	Pounds.
17	38,080	44	98.560
18	40,320	45	100,800
19	42,560	46	103,040
20	44,800	47	105.280
21	47,040	48	107.520
22	49,280	49	109.760
23	51,520	50	112,000
24	53,760	51	114,240
25	56,000	52	116,480
26	58,240	53	118,720
27	60,480	54	120,960
28	62,720	55	123,200
29	64,960	56	125,440
30	67,200	57	127,680
31	69,440	58	129,920
32	71,680	59	132,160
33	73.920	60	134,400
34	76,160	61	136.640
35	78,400	62	138.880
36	80,640	63	141.120
37	82,880	64	143,360
38	85,120	65	145.600
39	87.360	66	147,840
40	89,600	67	150,080
41	91,840	68	152.320
42	94,080	69	154.560
43	96,320	70	156,800

NOTE.—1 Ton = 2,240 lbs.

APPENDIX.

FORMS

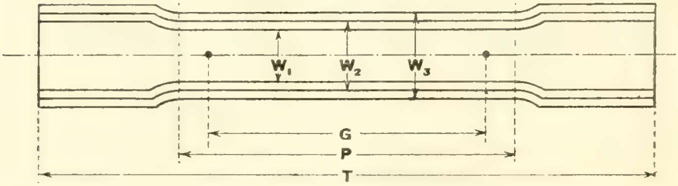
OF

BRITISH STANDARD TENSILE TEST PIECES.

APPENDIX I.

FORMS
OF
BRITISH STANDARD TENSILE TEST PIECES.

TEST PIECE **A.**

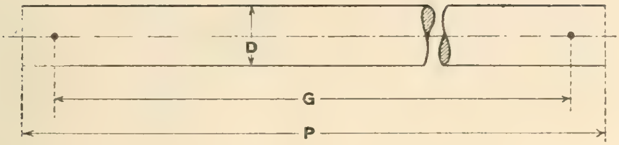


Gauge Length **G** = 8 inches.
Parallel Length **P** to be not less than 9 inches.
Total Length **T** = About 18 inches.

Thickness of Test Piece.	Maximum Width allowed.
Over $\frac{7}{8}$ in. (0·875 in.).	$\mathbf{W}_1 = 1\frac{1}{2}$ ins.
$\frac{3}{8}$ in. (0·375 in.) to $\frac{7}{8}$ in. (0·875 in.).	$\mathbf{W}_2 = 2$ ins.
Under $\frac{3}{8}$ in. (0·375 in.).	$\mathbf{W}_3 = 2\frac{1}{2}$ ins.

The widths of the test pieces for plates were selected to comply with the two following conditions. (1) As the great bulk of plates to be tested are from $\frac{3}{8}$ inch to $\frac{7}{8}$ inch thick, it was desirable for the sake of convenience that the test pieces for such plates should be of uniform width, and, in accordance with very general practice, a width of 2 inches was selected. (2) With a test piece of a given form, the percentage of elongation was found to be less for thick plates than for thin ones; with steel of the same quality in other respects it was desirable therefore to choose widths of test piece which would be slightly in favour of the thicker plates. This is secured with the widths selected for the Standard Test piece of form **A.**

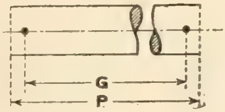
TEST PIECE **B.**



Gauge length **G** to be not less than 8 times the diameter **D.**
With enlarged ends:—Parallel Length **P** to be not
less than 9 times the reduced diameter **D.**

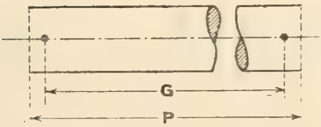
All test pieces of form **B** are strictly similar, and for the same material give the same percentage of elongation. They are nearly similar to a test piece of form **A,** 8 inches in gauge length, 2 inches wide and $\frac{3}{8}$ inch thick.

TEST PIECE **C.**



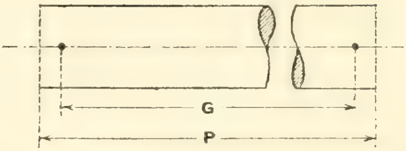
Gauge Length **G** = 2 inches.
Parallel Length **P** to be not less than $2\frac{1}{4}$ inches.
Dia. = 0·564 inch.
Area = $\frac{1}{4}$ sq. inch.

TEST PIECE **D.**



Gauge Length **G** = 3 inches.
Parallel Length **P** to be not less than $3\frac{3}{8}$ inches.
Dia. = 0·798 inch.
Area = $\frac{1}{2}$ sq. inch.

TEST PIECE **E.**

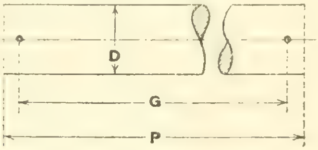


Gauge Length **G** = $3\frac{1}{2}$ inches.
Parallel Length **P** to be not less than 4 inches.
Dia = 0·977 inch.
Area = $\frac{3}{4}$ sq. inch.

Test Pieces **C, D,** and **E** were arranged to meet the very common practice of making test pieces for forgings, axles, tyres, etc., of either $\frac{1}{4}$ square inch or $\frac{1}{2}$ square inch in sectional area. With the gauge lengths decided upon, these three forms are very nearly similar, and, for a given material, give very approximately the same percentage of elongation. Though not exactly, they are approximately similar to the Standard Test Piece **F,** and for the same material give a nearly identical, but slightly greater, percentage of elongation.

TEST PIECE **F.**

(For Test Pieces over 1 inch diameter.)



Gauge Length **G** to be not less than 4 times the diameter **D.**
With enlarged ends:– Parallel Length **P** to be not less than $4\frac{1}{2}$ times the reduced diameter **D.**

In some testing machines it was found inconvenient to use form **B** for bars of over 1 inch in diameter, and form **F** of half the gauge length is designed to meet such cases. For a given material the percentage of elongation with Test Piece **F** is greater than with Test Piece **B,** and this difference is provided for in the British Standard Specifications.

FORM OF ENDS.

In the case of the round Test Pieces **B, C, D, E** and **F,** the form of the ends is to be as required in order to suit the various methods employed for gripping the test piece. When enlarged ends are used the length of the parallel portion of the test piece must in no case be less than that noted on the diagrams.

British Engineering Standards Association.

PRICE LIST
OF
BRITISH STANDARD SPECIFICATIONS AND REPORTS.

FEBRUARY, 1919.

(*This List cancels all previous Lists.*)

NOTE.—*A number of the Publications of the Association are being issued in French, Italian, Spanish and Portuguese. Both the English Editions and the Foreign Translations (which also include the English text) are being published in octavo form, and will be available at 1/- net per copy or its equivalent in Foreign moneys.*

Report No.		Net.	Post free.
1-1914.	**Rolled Sections for Structural Purposes,** Lists of	1/-	1/2
2-1903.	**Tramway Rails and Fishplates,** Specification and Sections of	1/-	1/3
3-1903.	**Influence of Gauge Length and Section of Test Bar on the Percentage of Elongation,** Report on, by Professor W. C. UNWIN, F.R.S.	1/-	1/2
4-1903.	**Beams,** Properties of (included in No. 6)	Withdrawn.	
5-1905.	**Locomotives for Indian Railways,** First Report on (Superseded by No. 50)	Withdrawn.	
6-1904.	**Rolled Sections for Structural Purposes,** Properties of ...	1/-	1/3
7-1910.	**Copper Conductors,** Tables of	1/-	1/3
8-1904.	**Tramway Poles,** Specification for Tubular	1/-	1/2
9-1909.	**Railway Rails,** Specification and Sections of Bull Head	1/-	1/3
10-1904.	**Pipe Flanges,** Tables of ...	1/-	1/2
11-1909.	**Railway Rails,** Specification and Sections of Flat Bottom ...	1/-	1/4
12-1915.	**Portland Cement,** Specification for	1/-	1/2
13-1910.	**Steel for Shipbuilding,** Specification for Structural	1/-	1/2
14-1907.	**Steel for Marine Boilers,** Specification for Structural	1/-	1/2
15-1912.	**Steel for Bridges,** etc., and General **Building Construction,** Specification for Structural	1/-	1/2
16-1905.	**Telegraph Material,** Specification for	1/-	1/5
17-1904.	**Electrical Machinery.** Report on (Superseded by No. 72-1917)	Withdrawn.	
18-1910.	**Tensile Test Pieces,** Forms of	Gratis	-/2
19-1905.	**Temperature Experiments on Field Coils** of Electrical Machines, Report on	1/-	1/3
20-1913.	**Screw Threads,** Report on	1/-	1/2
21-1909.	**Pipe Threads** for **Iron or** Steel Pipes and Tubes, Report on ...	1/-	1/2
22-1905.	**Insulating Materials,** Report on the **Effect of Temperature** on	Withdrawn.	
23-1905.	**Trolley Groove and Wire,** Standards for	1/-	1/2
24-1911.	**Railway Rolling Stock,** Specifications for **Material** used in the Construction of—		
	Part I. Locomotive, Carriage and Wagon Axles	1/-	1/2
	,, **II.** Locomotive, Carriage and Wagon Tyres	1/-	1/2
	,, **III.** Laminated, Volute and Helical Springs and Steel for Laminated Springs ...	1/-	1/2
	,, **IV.** Steel Forgings, Blooms and Castings	1/-	1/2
	,, **V.** Copper Plates, Rods and Tubes and Brass Tubes ...	1/-	1/2
	,, **VI.** Steel Plates, Angles, etc., and Rivets for Locomotives, Carriages and Wagons	1/-	1/2
25-1906.	**Errors in Workmanship,** Report on	Withdrawn	
26-1907.	**Locomotives for Indian Railways,** Second Report on (Superseded by No. 50)	Withdrawn.	
27-1906.	**Limit Gauges for Running Fits,** Report on Standard Systems of	1/-	1/2
28-1908.	**Nuts, Bolt Heads and Spanners,** Report on	1/-	1/2
29-1909.	**Steel Forgings for Marine Purposes,** Specification for Ingot ...	1/-	1/2
30-1907.	**Steel Castings for Marine Purposes,** Specification for ...	1/-	1/2
31-1910.	**Steel Conduits for Electrical Wiring,** Specification for ...	1/-	1/2
32-1907.	**Steel Bars** for use in **Automatic Machines,** Specification for	1/-	1/2
33-1906.	**Carbon Filament Glow Lamps,** Specification for	1/-	1/2
34-1913.	**Screw Threads,** Tables of British Standard Whitworth, British Standard Fine and British Standard Pipe Threads	Withdrawn.	

LIST OF PUBLICATIONS—*continued.*

Report No.		Net.	Post free.
35-1907.	**Copper Alloy Bars** for use in **Automatic Machines,** Specification for	1/-	1/3
36-1907.	**Electrical Machinery,** Report on (Superseded by No. 72-1917)	Withdrawn.	
37-1919.	**Electricity Meters,** Specification for	1/-	1/2
38-1913.	**Limit Gauges for Screw Threads,** Report on Standard Systems for	Withdrawn.	
39-1908.	**Screw Threads,** Combined Reports on	Withdrawn.	
40-1908.	**Cast Iron Low Pressure Heating Pipes,** Specification for Spigot and Socket	1/-	1/2
41-1908.	**Cast Iron Flue or Smoke Pipes,** Specification for Spigot and Socket	1/-	1/2
42-1909.	**Steam Engines for Electrical Purposes,** Report on Reciprocating	1/-	1/2
43-1909.	**Boiler Tubes,** Specification for Charcoal **Iron** Lap-welded	1/-	1/2
44-1909.	**Cast Iron Pipes for Hydraulic Power,** Specification for	1/-	1/2
45-1917.	**Sparking Plugs** (for Internal Combustion Engines), Report on Dimensions for	1/-	1/2
46-1909.	**Keys and Keyways,** Specification for	1/-	1/2
47-1914.	**Steel Fishplates** for Bull Head and Flat Bottom Railway Rails, Specification and Sections of	1/-	1/3
48-1909.	**Wrought Iron** of Smithing Quality for Shipbuilding (Grade D), Specification for	1/-	1/2
49-1909.	**Ammeters and Voltmeters,** Specification for	1/-	1/2
50-1910.	**Locomotives for Indian Railways,** Third Report on (Superseding Nos. 5 and 26)	Under Revision.	
51-1913.	**Wrought Iron** for use in Railway Rolling Stock ("Best-Yorkshire" and Grades A, B and C), Specification for	1/-	1/2
52-1910.	**Lampholders and Caps,** Specification for Bayonet Socket	Under Revision.	
53-1913.	**Boiler Tubes** for Locomotive Boilers, Specification for Cold Drawn Weldless **Steel**	1/-	1/2
54-1911.	**Screw Threads, Nuts and Bolt Heads** for use in **Automobile** Construction, Report on	1/-	1/2
55-1911.	**Copper and Bronze Wire,** Report on Hard Drawn	1/-	1/3
56-1911.	**Yield Point** and **Elastic Limit,** Definitions of	Gratis.	-/2
57-1911.	**Small Screws,** Report on Heads for	1/-	1/2
58-1912.	**Cast Iron Soil Pipes,** Specification for Spigot and Socket	1/-	1/2
59-1912.	**Cast Iron Waste and Ventilating Pipes** (for other than Soil Purposes), Specification for Spigot and Socket	1/-	1/2
60-1913.	**Tungsten Filament Glow Lamps** (Parts 1 and 2), Report on Experiments on	1/-	1/6
61-1913.	**Copper Tubes** and their **Screw Threads** (primarily for domestic and similar work), Specification for	1/-	1/3
62-1913.	**Marine Boiler Stays, Screwing** for	Gratis.	-/2
63-1913.	**Broken Stone and Chippings,** Specification for Sizes of	1/-	1/2
64-1913.	**Fishbolts and Nuts** for Railway Rails, Specification for	1/-	1/2
65-1914.	**Salt-Glazed Ware Pipes,** Specification for	1/-	1/2
66-1914.	**Copper-Alloy Three-Piece Unions** (for Low and Medium Pressure Screwed Copper Tubes), Specification for	1/-	1/3
67-1914.	**Ceiling Roses,** Specification for Two- and Three-Plate	1/-	1/2
68-1914.	**Steel Conductor Rails,** Method of Specifying the **Resistance** of	1/-	1/2
69-1915.	**Tungsten Filament Glow Lamps** (Vacuum Type) for **Automobiles,** Report on	1/-	1/2
70-1915.	**Pneumatic Tyre Rims** for Automobiles, Motor Cycles and Cycles, Report on	1/-	1/2
71-1917.	**Wheel Rims and Tyre Bands for Solid Rubber Tyres** for **Automobiles,** Report on Dimensions of	1/-	1/2
72-1917.	**Electrical Machinery,** British Standardisation Rules for	1/-	1/2
73-1915.	**Wall Plugs and Sockets,** Specification for	1/-	1/2
74-1917.	**Charging Plug and Socket,** for Vehicles Propelled by Electric Secondary Batteries, Specification for	1/-	1/2
75-1916.	**Steels for Automobiles,** Specification for **Wrought**	1/-	1/2
76-1916.	**Tars, Pitches, Bitumens** and **Asphalts** when used for Road Purposes, Report on **Nomenclature** of and Specifications for **Tar** and **Pitch** for Road Purposes	1/-	1/2
77-1916.	**Electrical Pressures** for **New Systems** and **Installations** (Low and Medium Pressures)	Gratis	-/2
78-1917.	**Cast Iron Pipes** and Special Castings for **Water, Gas** and **Sewage,** Specification for	1/-	1/3
80-1917.	**Magnetos for Automobile Purposes,** Report on Dimensions of	1/-	1/2
82-1919.	**Starters for Electric Motors** (Face Plate Type), Specification for	1/-	1/2
83-April, 1918.	**Dope** and **Protective Covering** for **Aircraft,** Standard of Reference for	1/-	1/2
84-1918.	**Screw Threads (British Standard Fine), B.S.F.,** and their **Tolerances,** Report on	1/-	1/2
85-April, 1918.	**Steel** for **Aircraft** for **Government Purchases** in the **United States of America,** Specifications for	Under Revision.	
86-1919.	**Magnetos for Aircraft Purposes,** Report on Dimensions of	1/-	1/2
87-1919.	**Airscrew Hubs,** Report on Dimensions of	1/-	1/2
88-1919.	**Electric Cut-Outs** (Low Pressure, Type O), Specification for	1/-	1/2

INTERIM REPORTS.

C.L. 2582.	**Ball Journal Bearings for Automobiles,** Interim Report on Sizes of Single Row	Gratis	-/2
C.L. 3750.	**French Metric Screw Threads** for **Aircraft** Purposes, Interim Report on	-/6	-/8

Printed by
Waterlow & Sons Limited, 49, Parliament Street,
Westminster, S.W. 1.